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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/900,411	07/06/2001	Kazim Ozbaysal	13DV14050	5957

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MCNEES, WALLACE & NURICK
100 PINE STREET
BOX 1166
HARRISBURG, PA 17108

EXAMINER	
OLTMANS, ANDREW L	
ART UNIT	PAPER NUMBER
1742	

12

DATE MAILED: 07/08/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/900,411	Applicant(s) OZBAYSAL, KAZIM	
	Examiner Andrew L Oltmans	Art Unit 1742	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *26 June 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-21* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Note Regarding Final Action

1. In view of applicant's comments and reconsideration of the previous rejection, the finality of the previous Office Action has been withdrawn. Therefore, this Office Action is NON-FINAL.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

ASM Handbook Volume 2, "Properties and Selection of Nonferrous Alloys and Special-Purpose Materials, 1992 in view of ASM Handbook Volume 4, "Heat Treating", 1991

3. Claims 1, 4-6, 8, 9, 12, 13, 16, 17 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over ASM Handbook Volume 2, "Properties and Selection of Nonferrous Alloys and Special-Purpose Materials, 1992 (ASM Handbook Vol. 2) in view of ASM Handbook Volume 4, "Heat Treating", 1991 (ASM Handbook Vol. 4).

ASM Handbook Vol. 2 teaches the process steps claimed, including the heating to greater than about 1600°F, cooling to less than about 800°F, heating a second time to a temperature from about 1275°F to about 1375°F and cooling, are conventional processing steps known in the art for producing α-β titanium alloys and particularly α-β titanium alloys containing a martensitic

structure, as show in the ASM Handbook, described below. The claimed composition is a known α-β titanium alloy known as IMI-550 (see e.g. Volume 2, Section 3, page 11, Table 25):

Table 25 Temperature range and chemical composition of high-temperature titanium alloys, listed in order of introduction

Alloy designation	Year of introduction	Useful maximum temperature		Approximate nominal chemical composition, wt%							
		°C	°F	Al	Sn	Zr	Mo	Nb	V	Si	Others
Ti-6Al-4V	1954	300	580	6	...	...	...	...	4	...	...
IMI-550	1956	425	795	4	2	...	4	...	...	0.5	...

During wrought alloy processing, α-β titanium alloys, such as IMI-550 typically, are subject to heat treatments, such as Duplex anneal, Solution treat and age, Beta anneal, Beta quench, Recyrstallize anneal, or Mill anneal, depending on desired microstructure, wherein these known processing steps include steps that yield α' microstructure (see Volume 2, Section 2, page 19). The microstructure α' includes the martensitic structure instantly claimed (Volume 2, Section 2, pages 12-13):

> "The basis for microstructural manipulation during heat treatment of titanium alloys centers around the $\beta \rightarrow \alpha$ transformation that occurs in these alloys during cooling. This transformation can occur by nucleation and growth, or it can occur martensitically, depending on the alloy composition and the cooling rate. The martensitic product is usually hcp and is designated α'. There also is an orthorhombic martensite, designated α'', which forms in alloys that contain higher concentrations of refractory elements such as molybdenum, tantalum, or niobium. Literally all thermomechanical processing is conducted above the M_s temperature for either α' or α''. Alloys that contain enough β-stabilizing elements to depress the M_s temperature below room temperature can be

rapidly cooled to retain the metastable β phase. More detailed information of the phase transformations in titanium alloys is given in several of the "Selected References" listed at the end of this article."

The heat treatments typically used on α-β titanium alloys, such as IMI-550 typically, are subject to heat treatments including the heat treatment "Beta anneal" that includes heating to a the claimed heating to greater than about 1600°F (i.e. about 15°C of about beta transus), cooling to less than about 800°F (i.e. water quench), heating a second time to a temperature from about 1275°F to about 1375°F (i.e. temper at 650-760°C) (Volume 2, Section 2, page 19, Table 19):

Table 19 Summary of heat treatments for alpha-beta titanium alloys

Heat treatment designation	Heat treatment cycle	Microstructure
Duplex anneal	Solution treat at 50-75 °C below $T\beta$[(a)], air cool and age for 2-8 h at 540-675 °C	Primary α, plus Widmanstätten $\alpha+\beta$ regions
Solution treat and age	Solution treat at ~40 °C below $T\beta$, water quench[(b)] and age for 2-8 h at 535-675 °C	Primary α, plus tempered α' or a $\beta+\alpha$ mixture
Beta anneal	Solution treat at ~15 °C above $T\beta$, air cool and stabilize at 650-760 °C for 2 h	Widmanstätten $\alpha+\beta$ colony microstructure
Beta quench	Solution treat at ~15 °C above $T\beta$, water quench and temper at 650-760 °C for 2 h	Tempered α'
Recrystallization anneal	925 °C for 4 h, cool at 50 °C/h to 760 °C, air cool	Equiaxed α with β at grain-boundary triple points
Mill anneal	$\alpha+\beta$ hot work + anneal at 705 °C for 30 min to several hours and air cool	Incompletely recrystallized α with a small volume fraction of small β particles

Source: Ref 13

Cooling would necessarily take place after the tempering step in the Beta quench. It is noted that the ASM Handbook teaches that the beta transus for IMI-550 is 990°C in Volume 2, Section 2, page 10, Table 15. ASM Handbook Vol. 2 teaches that the cooling rates are critical, particularly in the range of 600-900°F, wherein slower cooling, such as furnace or air cooling, should be used to reduce residual stress (Volume 2, section 2, page 20):

> "Uniformity of cooling is critical, particularly in the temperature range from 480 to 315 °C (900 to 600 °F). Oil or water quenching should not be used to accelerate cooling because this can induce residual stresses by unequal cooling. Furnace or air cooling is acceptable."

ASM Handbook Vol. 2 teaches that forging processes are often utilized on titanium alloys, including IMI-550, wherein the forging is used to produce the shape of the final part (Volume 2, Section 2, page 4), as recited in claim 4 and 16. ASM Handbook Vol. 2 recites that the recommending forging temperatures for IMI-550 is 1650-1775°F, as recited in claim 5. With respect to claims 6 and 17, ASM Handbook Vol. 2 teaches that titanium articles may be weld repaired as an integral step in the manufacturing process and is used to eliminate surface-related defects (Volume 2, Section 4, page 1).

ASM Handbook Vol. 2 fails to meet all the limitations of the instant claims in that ASM Handbook Vol. 2 remains silent to the cooling rate after the tempering step in the Beta quench and remains silent to the conditions of the stress-relieving step.

However, one of ordinary skill in the art would have found the invention to be obvious because one of ordinary skill in the art would have been motivated to use a slow cooling, such as air or furnace cooling, particular through the temperatures used in tempering (e.g. 800°F,as claimed), in order to provide the desirable result of a uniformity of cooing and to reduce residual stresses, as taught in the ASM Handbook, Volume 2, section 2, page 20. With respect to the

particular rate claimed, one of ordinary skill in the art would have expected that the rate of air or furnace cooling to necessarily have a cooling rate of less than 15°F/sec, as recited in claims 1, 8 and 12.

Supportive of the assertion that air or furnace cooling has a rate of less than 15°F/sec is the teaching of the ASM Handbook Vol. 4 which recites examples of similar titanium alloys undergoing similar heat treatment processes having air cooling rate and furnace cooling rate falling within the claimed range (Volume 4, Section 1, page 5):

> Other Special Thermal Treatments. Certain physical properties, such as notch strength, fracture toughness, and fatigue resistance, can be enhanced in some alloys by special thermal treatments. Three such treatments are:

- *Solution treating and overaging of Ti-6Al-4V:* Heat 1 h at 955 °C (1750 °F), water quench, hold 2 h at 705 °C (1300 °F), air cool. Advantages: improved notch strength, fracture toughness, and creep strength at strength levels similar to those obtained by regular annealing
- *Recrystallization annealing of Ti-6Al-4V or Ti-6Al-4V-ELI:* Heat 4 h or more at 925 to 955 °C (1700 to 1750 °F), furnace cool to 760 °C (1400 °F) at a rate no higher than 56 °C/h (100 °F/h), cool to 480 °C (900 °F) at a rate no lower than 370 °C/h (670 °F/h), air cool to room temperature. Advantages: improved fracture toughness and fatigue-crack-growth characteristics at somewhat reduced levels of strength
- *Beta annealing of Ti-6Al-4V, Ti-6Al-4V-ELI, Ti-6Al-2Sn-4Zr-2Mo, Ti-6Al-4V, or Ti-6Al-4V-ELI*: Heat 5 min to 1 h at 1010 to 1040 °C (1850 to 1900 °F), air cool to 650 °C (1200 °F) at a rate of 85 °C/min (150 °F/min) or higher, then heat 2 h at 730 to 790 °C (1350 to 1450 °F), air cool. Advantages: improved fracture toughness, high cycle fatigue strength and resistance to aqueous stress corrosion. Ti-6Al-2Sn-4Zr-2Mo: Heat $\frac{1}{2}$ h at 1020 °C (1870 °F), air cool, then hold 8 h at 595 °C (1100 °F), air cool. Advantages: improved creep strength at elevated temperatures and improved fracture toughness. Disadvantages: Beta annealing of α-β alloys produces relatively low tensile ductility. In recent years, recrystallization annealing has replaced β annealing for fracture-critical airframe components

With respect to the stress relieving step recited in claims 9 and 19, one of ordinary skill in the art would have found the step of stress relieving obvious because ASM Handbook Vol. 2,

section 2, page 20 teaches that stress relieving is a desirable process step in order to provide a product that has shape stability, and eliminates loss of compressive yield strength (Volume 2, Section 2, page 20). With respect to the specific times and temperatures, one of ordinary skill in the art would have found the teaching of the ASM Handbook sufficiently enabling to perform the stress relieving in a manner sufficient for the taught use of providing a product that has shape stability and eliminates loss of compressive yield strength (Volume 2, section 2, page 20), including the temperature of 1000°F to 1050°F (Volume 2, section 2, page 20):

> " Stress-relieving treatments must be based on the metallurgical response of the alloy involved. Generally, this requires holding at a temperature sufficiently high to relieve stresses without causing an undesirable amount of precipitation or strain aging in alpha-beta and beta alloys, or without producing undesirable recrystallization in single-phase alloys that rely on cold work for strength. The higher temperatures usually are used with shorter times, and the lower temperatures with longer times, for effective stress relief. During stress relief of solution-treated and aged titanium alloys, care should be taken to prevent overaging to lower strength. This usually involves selection of a time-temperature combination that provides partial stress relief."

ASM Handbook Volume 2, "Properties and Selection of Nonferrous Alloys and Special-Purpose Materials, 1992 in view of ASM Handbook Volume 4, "Heat Treating", 1991 in further view of Ruckle 4,631,092

4. Claims 2, 3, 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over ASM Handbook Volume 2, "Properties and Selection of Nonferrous Alloys and Special-Purpose Materials, 1992 (ASM Handbook Vol. 2) in view of ASM Handbook Volume 4, "Heat Treating", 1991 (ASM Handbook Vol. 4) in further view of Ruckle 4,631,092 (Ruckle).

The ASM Handbook, Volumes 2 and 4 teach and are applied as set forth above in paragraph 3.

The ASM Handbook, Volumes 2 and 4 fail to meet all the limitations of the instant claims in that the ASM Handbook does not explicitly teach a gas turbine engine compressor blade, nor a part having one section of thickness greater than 0.2 inches and one section of less than 0.2 inches.

Ruckle teaches that titanium articles similar to those of the claimed invention may be used in compressor blades for gas turbine engines (col 1, lines 42-44).

One of ordinary skill in the art at the time that the invention was made would have found the claimed invention obvious because one of ordinary skill in the art would have been motivated to use the alloy of the ASM Handbook in a gas turbine compressor blade, as taught by Ruckle, with the dimensions taught by Ruckle, because such an alloy has desirable strength properties for such an application (see e.g. ASM Handbook, Volume 2, section 3, page 4, Table 21 and Volume 2, section 3, page 6, Table 6).

ASM Handbook Volume 2, "Properties and Selection of Nonferrous Alloys and Special-Purpose Materials, 1992 in view of ASM Handbook Volume 4, "Heat Treating", 1991 in further view of Whang 4,512,826

5. Claims 7, 10, 11, 18, 20 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over ASM Handbook Volume 2, "Properties and Selection of Nonferrous Alloys and Special-Purpose Materials, 1992 (ASM Handbook Vol. 2) in view of ASM Handbook Volume 4, "Heat Treating", 1991 (ASM Handbook Vol. 4) in further view of Whang 4,512,826 (Whang).

The ASM Handbook, Volumes 2 and 4 teach and are applied as set forth above in paragraph 3.

The ASM Handbook, Volumes 2 and 4 fail to meet all the limitations of the instant claims in that the ASM Handbook does not explicitly teach the heat treating for 4-6 hours, nor the wrapping of the part in tantalum foil for the process.

Whang teaches that aging of titanium alloys can be conducted from 2-10 hours (col 4, lines 18-23), as recited in claims 7, 10, 18 and 20. Whang also teaches that the titanium alloy parts can be wrapped in tantalum foil in order to prevent contamination of the parts (col 7, lines 8-15), as recited in claims 11 and 21.

One of ordinary skill in the art at the time that the invention was made would have found the claimed invention obvious because one of ordinary skill in the art would have been motivated to wrap the part in tantalum foil and perform the heat treating for a time of 2-10 hours on the alloys of the ASM Handbook, as taught by Whang, because it would be useful for creating the desirable phase structure and preventing contamination, as taught in Whang.

Response to Arguments

6. As stated above, in view of applicant's comments and reconsideration of the previous rejection, the finality of the previous Office Action has been withdrawn. Therefore, this Office Action is NON-FINAL.

7. Applicant's arguments with respect to claims 1-21 have been considered but are moot in view of the new ground(s) of rejection. Claims 1-21 remain pending in this application. Upon reconsideration, the rejection under 35 USC 112, first paragraph has been withdrawn.

8. In response to applicant's request for a copy of the ASM Handbook, the Examiner has provided copies of the electronic versions of the ASM Handbook. For convenience and to avoid

confusion only the relevant chapters have been reproduced. The Examiner is only relying upon the chapters reproduced. In order to provide a reference to particular sections, the examiner has numbered the pages and labeled the sections as follows:

Volume 2: Section A	Publication Information and Contributors
Volume 2: Section 1	Wrought Titanium and Titanium Alloys: "Titanium Alloys" (pages 1-15)
Volume 2: Section 2	Wrought Titanium and Titanium Alloys: "Wrought Alloy Processing" (pages 1-23)
Volume 2: Section 3	Wrought Titanium and Titanium Alloys: "Properties" (pages 1-21)
Volume 2: Section 4	Titanium and Titanium Alloy Castings: "Weld Repair" (page 1)
Volume 4: Section A	Publication Information and Contributors
Volume 4: Section 1	Heat Treating of Titanium and Titanium Alloys: "Solution Treating and Aging"

9. The examiner notes and acknowledges applicant's arguments; however, the arguments are inapplicable to the newly presented rejections.

Conclusion

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Andrew L. Oltmans whose telephone number is 703-308-2594. The examiner can normally be reached 7:00-3:30 Monday-Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Roy King can be reached on 703-308-1146. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

ALo

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July 5, 2003

John P. Sheehan
Primary Examiner
Art Unit 1742

ROY KING
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 1700